1 512 823

# PATENT SPECIFICATION (11) 1 512 823

(21) Application No. 24715/75 (22) Filed 9 June 1975
(31) Convention Application No. 70281
(32) Filed 10 June 1974 in
(33) Luxembourg (LU)
(44) Complete Specification published 1 June 1978
(51) INT CL² A45D 7/02
(52) Index at acceptance
A4V 14A1 14A2 14A3 14A4 14A5B 14C


(72) Inventors DANIEL BAUER
JULES LEROY and
JEAN-PAUL BECK

## (54) PROCESS AND APPARATUS FOR WAVE-SETTING AND TREATMENT OF HAIR

(71) We, L'OREAL, a French Body Corporate of 14, rue Royale, 75008 Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a new process for carrying out wave-setting or treatments of human hair, and to apparatus for carrying out this process.

It is known that the term wave-setting is applied to the operation which consists of giving the hair a non-definitive shape, that is to say a temporary shape which disappears when the hair is again wetted, in particular when the hair is next shampooed.

In other words, the difference between a permanent set (change in shape) of the hair implying a chemical treatment and a wave-set resides in the fact that on moistening or washing, hair which has been wave-set recovers the shape which it had before the wave-setting, whilst after a permanent set, the shape of the hair is not changed by moistening or by washing.

The most commonly used hair wave-setting process consists of starting from wet hair which is wound up on supports called curlers (or wave-setting rollers) and of then drying the hair under a hood at a temperature of between 30° and 60°C for a period which can vary from 20 to 60 minutes depending on the mass of the hair to be dried. Thereafter, it is necessary merely to remove the curlers or wave-setting rollers and to give the hair style a final combing-out.

In a variant of the wave-setting process the hair is impregnated with a wave-setting lotion which can consist, for example, of a solution of strengthening agents, such as resins, which, after drying, form a sheath over the hair and keep the hair in position.

Another known but less used technique consists of starting from dry hair which is wound on curlers and is moistened with water, if appropriate sprayed in fine droplets, before or after winding up on curlers or wave-setting rollers, or is subjected to the action of a mixture of air and steam heated to a level which the scalp can withstand, that is to say at most of the order of 65°C, and blown towards the hair by means of a blower hood or a manual hair-drier.

Finally, another wave-setting process consists of using the old technique of the curling iron or hair-styling iron. With this last process, the hair is heated non-uniformly to a temperature in excess of 100°C by applying it to a hot metallic mandrel. Optionally, steam, which may be produced by the iron itself, is applied to moisten the hair before or during the treatment. This moisture has to be removed by evaporation before hair is released from the heating mandrel, and this operation lasts about 20 seconds.

These last two processes are rather infrequently practised because they give results which overall are considered not very satisfactory. In particular, wave-setting by means of the curling iron has the disadvantage that the hair is treated non-uniformly and is subjected to very different temperatures depending on whether it is in contact with the heating mandrel or is fairly distant therefrom.

It follows, from the studies and experiments which the Applicant Company has carried out, that the best results in wave-setting are obtained if (a) the hair is heated to a uniform temperature whilst held in the shape which it is desired to give the hair, that is to say, in practice, wound up on curlers or wave-setting rollers, and (b) at the end of the application of heat the hair contains the amount of water corresponding to the equilibrium state at

ambient temperature in an atmosphere of average humidity.

It has in fact been found by the applicant company that wave-sets stay in less well if, after the wave-setting operation, the hair has either to take up or to loose moisture in order to adapt itself to the ambient hygrometric conditions.

According to one aspect of the present invention we provide a process for treating hair, comprising supporting at least one lock of hair in a desired configuration either when dry or nearly dry, applying uniformly to the hair superheated steam at a temperature of above 100°C and for a period of up to 60 seconds, and maintaining the hair in said configuration when it then cools to ambient temperature.

As a result, with this invention it is possible to achieve a good wave-set in that all the hair is heated to a uniform temperature and is given a controlled humidity which is substantially the same at different points of the hair, especially at the surface and at the central part of the hair.

The process of the present invention makes it possible simply and economically to achieve a perfectly homogeneous hydration treatment of the hair at a sufficiently high temperature to achieve a wave-set, whilst imparting to the hair a water content which substantially corresponds to the state of equilibrium with the atmosphere in which the hair will subsequently find itself.

This process can be applied to dry hair i.e. (a) hair which has not just been washed but is wound up on curlers or wave-setting rollers, or (b) hair which may have just been washed and have then been subjected to a drying operation which is nearing completion in which case the steam is applied at a time when the hair is not yet completely dry, or (c) may have been washed only recently and therefore clean but not "just washed", or (d) may even to a certain degree be dirty, in which case the process according to the invention will be found to subject it to a cleaning action which renders it more glossy and very largely eliminates its greasy condition.

It is notable that the heating of the hair which creates the wave-set is effected totally or mainly by application of steam superheated to a temperature of between 100° and about 150°C, which uniformly bathes the hair and penetrates all the fibres.

The process according to the invention can be used without employing any high temperature heating element in contact with the hair, but in certain applications it is possible to introduce superheated steam at above 100°C whilst the hair is wound up on a cylindrical mandrel of which the external temperature is raised to above ambient temperature but must remain at a temperature below about 70°C; the temperature of this mandrel must be considerably below the temperature at which the wave-setting operation by modification of the hydrogen bonds of keratin is carried out. This relatively low temperature substantially eliminates the risk of burning of the user by contact with the warm mandrel.

After application of the superheated steam at a temperature of between 100 and about 150°C, the cooling of the lock of hair wound up on a curler or wave-setting roller may be effected by a stream of air, for example at ambient temperature, before the curlers are taken out.

The process according to the present invention makes it possible to effect a considerable improvement in wave-setting even relative to those conventional wave-settings which were hitherto considered to be the best.

First of all, a considerable improvement in the hold of the wave-set is observed; under the action of atmospheric humidity, the hair does not resume its initial shape until after a longer period than with previous treatments.

It is also noted that the treated hair is softer, that the colours of the head of hair are revived to a greater extent and are more striking, that the hair is glossier and that it becomes greasy again less rapidly after the wave-set. Furthermore, particularly in the case of fine hair, the body of the hair is greater after the wave-set according to the invention.

It is also noteworthy that whilst the scientific literature mentions the degradation of keratin chains by steam at temperatures of between 100 and about 150°C, the process according to the invention, even if applied repeatedly to the hair, produces no detectable change in its structure.

Thus chemical analyses which have been carried out on human hair which has undergone 32 successive applications of the process according to the invention (superheated steam at 120°C and applications for 5 seconds) have not shown any change in structure.

The process according to the invention also has the advantage that the properties which it imparts to the wave-set are even more marked if the hair which is being waveset has beforehand been made sensitive or undergone deterioration, for example as a result of bleaching treatments, permanent shaping treatments, or dyeing.

In one form of the process according to the invention, steam at a temperature of between 100° and about 150°C is passed into the

head of hair, the steam being either mixed with chemical compounds, for example in the form of solutions, azeotropes or suspensions, which act on the hair, or applied to hair pretreated by such compounds.

Thus, for example, a permanent set of the hair, that is to say a change in shape of the hair which resists wetting or washing, can be carried out by passing into the hair a mixture of superheated steam and a reducing gas in a first stage and a mixture of superheated steam and an oxidising gas in a second stage.

To carry out the first stage it is possible to use, for example, an aqueous solution of ammonium sulphite or of hydrazine, whilst a solution of hydrogen peroxide can be used to carry out the second stage.

The process according to the invention also enables the treatment with superheated steam at a temperature of between 100° and about 150°C to accelerate or bring about chemical reactions of compounds which are already present on the head of hair.

It is also possible, if desired, to bring about a reaction on the hair between a compound, which has already been applied to the hair and another compound which is carried onto the hair by the superheated steam.

With the process according to the invention, it is also possible to use a curler or roller which comprises a spongy substance which has beforehand been impregnated with a chemical composition which is activated by the superheated steam.

Experiments which have been carried out by the applicant company have shown, surprisingly, that the steam treatment according to the invention, used to carry out or initiate chemical reactions on the hair, has the great advantage of causing less deterioration of the hair than if the same chemical reactions are carried out conventionally. In the cases of the invention, these reactions tend to take place throughout the mass of hair and not at the surface of the latter, as is the case with the conventional treatments.

Results are thus obtained which are superior in intensity and are more rapid, and leave the surface of the hair in a better condition.

According to a further aspect of the present invention we provide apparatus for carrying out the process according to the invention, comprising a vaporising element which comprises a resistance heater and is communicated with an injector adapted to be engaged in, or applied against, the hair to be treated; a pumping device connected to a reservoir and to said vaporising element for delivering a predetermined quantity of a liquid from said reservoir into the vaporising element to be discharged via the injector in the form of steam at a temperature above 100°C., and a blowing and/or suction device for generating, and discharging adjacent said injector, a steam of air at ambient temperature.

Preferably, the blowing and/or suction device discharges its stream of ambient air across the rolled hair. The steam injector may advantageously be situated in the stream of air which is discharged by the blowing and/or suction device.

Preferably, the vaporising element is equipped with a thermostat so as to control the temperature to which the steam emitted by the apparatus is superheated. More preferably, the vaporising element consists of a body, for example a metal body, which contains heated metal shot, through which the liquid, and the steam generated by the vaporising element, pass.

Alternatively, the steam injector may be located above a diffuser outlet which discharges the stream of cool air. It is thus possible to pass the superheated steam directly into the lock of hair wound up on the curler, whilst the cool air diffuser outlet provides air circulation and cooling in the vicinity of the scalp to avoid a temperature rise in the scalp due to the steam.

In the simplest form, the steam injector consists of a hollow needle of which the end can be rounded and which is provided, near its end, with a plurality of orifices which are advantageously oblique to the axis of the needle and point backwards. This needle can be pushed through the curler or the wave-setting roller so as to open out at the centre of the lock of hair and create a steam circulation radially outwards from the centre, so as to carry out a uniform treatment of the hair.

In a particularly convenient embodiment of the invention, the passage of hot steam near the scalp because of carelessness by the user of the apparatus is avoided in that the injector is surrounded by a telescopic protective sleeve which is urged outwards to shut off the outlet orifices of the injector and to connect the vaporising element to further vents arranged laterally over the body of the apparatus. In order to pass steam into a lock of hair, the injector and its sleeve are pushed in, in the direction of the lock of hair. The injector can penetrate into the lock but the sleeve is designed to have a front stop face which cannot penetrate therein and is therefore pushed back towards the interior of the apparatus to expose the orifices located on the injector and to shut off the lateral steam evolution vents located in the body of the apparatus.

In a variant, the injector can consist of an

outlet adapted to discharge a plurality of streams of superheated steam onto the lock of hair.

In a different embodiment of the apparatus according to the invention it is possible to introduce into the vaporising chamber either water or some other liquid composition which is contained in a vessel under pressure or in a refill container which is preferably disposable.

In a particular mode of construction, the control action to start the passage of liquid into the vaporising chamber also simultaneously stops the air blowing.

The apparatus according to the invention can be of the type in which superheated steam is injected into a lock of hair wound up on an independent curler. It can also be of the type in which the apparatus itself constitutes a curler or curling iron, including a superheated steam generator including a vaporising element, a tubular perforated body onto which a lock of hair may be rolled, means for introducing superheated steam from said generator into the interior of said tubular perforated body, and means for separately introducing cooling air into the interior of said body for maintaining said body at a temperature lower than 70°C.

In the case where independent curlers or wavesetting rollers are used it is preferable to follow a procedure such that the lock wound up on the curler is not in direct contact with the scalp, thereby allowing thermal insulation of the latter. To achieve this end, it is possible to use various types of devices, such as, for example, curlers or wave-setting rollers equipped laterally with flanges or other members intended to space them from the scalp.

It is also possible to use ordinary curlers equipped with members such as pins or supports which keep the curlers at a distance from the scalp.

Finally it is possible, according to the invention, to use as curlers or as wave-setting rollers, hollow members within which it is easy to engage the injector to introduce the steam into the curler.

In order that the invention may be better understood there will now be described, merely by way of illustration and without implying any limitation, several embodiments shown on the attached drawings, in which:—

Figure 1 is a schematic sectional view of a first embodiment of the apparatus according to the invention;

Figure 2 is a section along the line II—II of Figure 1;

Figure 3 is a section along the lines III—III of the vaporising element of the apparatus of Figures 1 and 2;

Figure 3a illustrates a variant of the injection needle which can be used in the apparatus according to the invention;

Figure 4 is a schematic view of an embodiment of the apparatus different from that of Figure 1;

Figure 5 is a front view of the injection and cool air diffusion head of Figure 4;

Figure 6 is a larger-scale view in section along the line VI—VI of Figure 5, showing the structure of the safety device;

Figure 7 is a sectional view of a variant of the injector;

Figure 8 is a schematic sectional view of a third embodiment of the apparatus according to the invention;

Figure 9 is a sectional view along the line IX—IX of Figure 8;

Figures 10 to 16 represent different embodiments of curlers which can be used for carrying out the process according to the invention;

Figure 17 shows a different embodiment of an injection device which can be used in the apparatus according to the invention;

Figure 18 represents a schematic sectional view of a different embodiment of the type of apparatus shown in Figure 8;

Figure 19 is a schematic sectional view of another embodiment of the apparatus according to the invention;

Figure 19a is a schematic sectional view of a refill container which can be used in the apparatus of Figure 19; and

Figure 20 represents a schematic sectional view of a different embodiment of the type of apparatus shown in Figure 19.

In Figure 1, one embodiment of an apparatus for carrying out the process according to the invention has been shown schematically. This apparatus consists of a body 1 connected to a handle 2.

The body 1 comprises, at its rear part, a motor 3 equipped with a fan 4 which provides a circulation of air within the body of the apparatus, in the direction shown by the arrows of Figure 1. This air is drawn in at the rear part of the body 1 and is passed through the nozzle 5.

A vaporising and superheating element 6 is placed inside the body 1 at the same end as the nozzle 5, so as to allow air to circulate around it.

This vaporising element 6 is connected to a hollow needle 7 which emerges at the front of the apparatus and is equipped at its end with discharge orifices 8 for injecting the steam into the centre of a curler or wave-setting roller.

The handle 2 has, at its lower part, a reservoir 9 equipped with a filling stopper 10. A mechanical pump 11, actuated by a trigger 12, is connected firstly to a tube 13 from the reservoir 9, and secondly to a tube 14 leading to the vaporising element 6. The pump 11 is of conventional construction

and comprises two one-way valves 15 and 16 which make it possible, each time the trigger is pressed in the direction of the arrow F, to send a predetermined quantity of liquid into the vaporising element 6.

As can be seen clearly in Figures 2 and 3, the vaporising element 6 consists of a metallic body 17 of flattened parallelepipedonal shape. This body is perforated by a central chamber 18 which has at one end an inlet nozzle 19 connected to the tube 14 and is connected at its other end to the hollow injector needle 7.

In the embodiment shown, the central orifice 18 is packed with small balls or other metallic bodies which make it possible rapidly to transfer the heat to the liquid which is passed into the vaporising element 6.

To either side of the chamber 18 are located two longitudinal bores 21 which contain electrical resistances fed by conductor wires 22.

A thermostatic switch 23, located below the vaporising element 6 makes it possible continuously to control the vaporisation temperature.

The vaporising element 6 is mounted in the body 1 of the apparatus by means of insulating pads 24 and rests both against the wall of the body 1 and against radial supports 25.

The lateral parts of the body 17 of the vaporising element are equipped with slots 26 to avoid conduction of an excessive amount of heat to the body 1 of the apparatus.

In the alternative embodiment shown in Figure 3a, the injector needle 7' has discharge orifices 8' which are oblique to the needle axis and point backwards so as further to reduce the risk of accidental damage to the scalp by the superheated steam.

It can be seen easily, from the description which has just been given, that the apparatus according to the invention continuously is capable of blowing a stream of cold air out through its nozzle 5 around the injector needle 7 or 7' and that each time the trigger 12 is pressed a predetermined quantity of the liquid contained in the reservoir 9 is fed to the vaporising element 6 so that the superheated steam escapes through the discharge orifices 8 and 8' of the injector needle 7 and 7' respectively.

By means of this apparatus it is easy to carry out the superheated steam treatment according to the invention, the stream of cool air ensuring firstly that the surround scalp areas are protected from the steam which is passed into the curler and secondly that the lock of hair wound up on the curler is cooled rapidly before the curler is removed.

Another embodiment of the apparatus according to the invention, which again shows the body 1 of the apparatus and its handle 2, has been shown schematically in Figure 4. The internal components of the apparatus such as the blower and the liquid pump have not been shown in detail because they can be of any type and because one suitable form has already been described above.

The vaporising and superheating element 6 has been shown schematically.

This element sends the superheated steam into an injector 27 which will be described in more detail later.

The stream of air from the blower is passed into a slot diffuser generally referenced 28, the structure of which can be seen more easily in Figure 5. This diffuser consists of a slot 29 which distributes a flat curtain of cold air propelled by the motor-driven fan omitted from the drawing.

Figure 5 also shows an embodiment comprising two laterally spaced parallel injector needles 7 which are identical and are each connected to the vaporising and superheating element 6.

It can be seen that by means of this embodiment it is possible to insert the two injector needles 7 into the curler on which the hair is wound up whilst a flat curtain of cooling air is blown by means of the diffuser 28 towards the scalp to avoid excessive heating of the scalp by the steam.

A sectional view of an injector 27 is shown on a larger scale in Figure 6.

This embodiment incorporates a further improvement of avoiding the escape of steam from the injector needle 7, which again has a plurality of discharge orifices 8, as in the previously described embodiment, to discharge several streams of steam when it is not desired to send the steam into a lock of hair.

In the device shown in Figure 6, the hollow injector needle 7 is surrounded by a protective sleeve 30 which is mounted to slide telescopically, movement of the sleeve being yieldably resisted by a return spring 31.

A stop 32 engaging slidably in a slot 33 of the sleeve 30 makes it possible to limit this to-and-fro movement.

The external end of the protective sleeve 30 has a widened-out head 34, the purpose of which will be explained later.

The orifice 35 which receives the needle 7 is connected to the superheated steam-generating element 6.

Vent orifices such as 36 connect the outside of the injector 27 to the bore 35 which contains the base of the needle 7.

Supplementary orifices 37 machined in

the needle 7 make it possible for the inside of the needle 7 (from which the superheated steam comes) to communicate with the peripheral zone into which these vent orifices 36 open.

In the position shown in solid lines on Figure 6, which corresponds to not using the injection of steam into the lock, the protective sleeve is pushed outwards by the spring 31 and shuts off the end discharge orifices 8 of the injection needle 7. On the other hand, the steam which arrives at the bore 35 can then be discharged outwards through the orifices 37 and 36. This discharge of steam takes place laterally and presents no danger of burning the scalp.

On the other hand if, in order to inject steam into the curlers, the sleeve is pushed against the curler, the widened-out head 34 of the sleeve cannot penetrate into the curler and is pushed back into the position shown in broken lines whilst the injector needle 7 penetrates into the curler. At the same time, the end discharge orifices 8 are exposed and the sleeve sliding inwards shuts off the inner orifices 37. As a result, in this position, shown in broken lines, the superheated steam is sent to the end of the injector needle and diffuses into the curler.

Of course, when the needle 7 is withdrawn from the curler, the protective sleeve again resumes the position shown in solid lines in Figure 6.

The air diffuser 28 is shown schematically in Figure 6.

A variant of the injector 27, according to which the superheated steam escapes through a porous mass 7a, for example of sintered metal, instead of escaping through discharge orifices of a needle, is shown in Figure 7. This results in a less rapid and more dispersed diffusion of the superheated steam.

Another embodiment of the apparatus according to the invention is shown schematically in Figure 8. Using this embodiment, the hair which is to be treated is actually wound up around the apparatus whilst, in the preceding embodiment, the steam was introduced by an injector which was temporarily inserted into a lock of hair wound up on a curler.

The embodiment of Figure 8 shows a motor 3 which operates a fan 4 to pass a stream of air, along the direction of the arrows, inside the body 1 of the apparatus.

The body 1 of the apparatus containing the motor 3 and the fan 4 is connected to a tubular part 38 provided with peripheral orifices 39.

A hinged gripper 40 controlled by a handle 41 and also itself equipped with orifices 42 can be applied against the tubular body 38 or removed therefrom in the manner of a conventional curling iron.

Inside the tubular part 38 is mounted an assembly which can slide axially and is composed of the following items: a push-button 43 for causing the injection of steam, a pressurised cartridge 44 containing the liquid to be vaporised, and a vaporising element 45 consisting, for example, of a porous body which can be produced by sintering. The porous body of the vaporising element in this embodiment may, alternatively, be formed of metal shot as in the embodiment of Figures 1 to 3, if desired.

The vaporising element includes an electrical resistance heater 21, preferably controlled by a thermostat (not shown), and a vaporising chamber 46 into which opens a conduit 47 from the reservoir 44 for the liquid under pressure.

A compression coil spring 48 continuously pushes the above-mentioned assembly to the left, as viewed in Figure 8, and abuts against the end of the vaporising element 45. When the members are in the position shown in Figure 8, the air introduced by the fan 4 passes through the turns of the coil spring 48.

In the embodiment described, the reservoir containing the liquid under pressure consists of a leakproof envelope 49 inside which is a membrane 50 which separates a volume 51 containing a gas under pressure from a volume 52 containing the liquid which is to be passed into the vaporising and superheating element 45.

The conduit 47 is firmly fixed to a valve 53 which is closed by the action of a strong compression spring 54. The conduit 47 is itself guided by a support 55 firmly fixed to the body of the apparatus.

The mode of operation of the apparatus described is as follows:

In the position shown, the fan emits cool air which flows in the direction of the arrows and this cool air diffuses through the lock which is wound up around the body 38 of the curler whilst held by the gripper 40.

When superheated steam is to be passed through the hair, it is merely necessary for the push-button 43 to be pressed in the direction of the arrow F. Moving the push-button towards the right first of all causes the assembly consisting of the reservoir 44 and the vaporising element 45 to move whilst the spring 48 is gradually compressed without initially causing the opening of the valve 53.

When the spring 48 has been completely compressed, the air inlet will have been shut off because the fan 4 feeds into a closed space.

Only at this moment is it possible to overcome this relatively strong return spring 54 and open the valve 53.

The gas under pressure contained in the volume 51 now expels some of the liquid contained in the volume 52, and the said liquid arrives in the vaporising chamber 46 where it is immediately converted to superheated steam. The steam can escape through the porous walls of the chamber 46 and thus arrives at the periphery of the vaporising element where its pressure reduces to atmosphere causing the steam to undergo further superheating treatment, after which it is discharged through the orifices 39 in the wall of the tubular body 38. The steam which has been superheated in this way uniformly passes through the lock or locks of hair wound up around the element 38.

To stop the passage of steam, it is merely necessary to relax the pressure on the push-button 43, and the springs 48 and 54 return the various parts to the positions shown in Figure 8, once again allowing cool air to be discharged through the orifices 39 so as to cool the hair rapidly.

Finally, the handle 41 is depressed to release the lock or locks of hair which had beforehand been wound up on the body 38 of the apparatus.

A sectional view has been shown in Figure 9, which shows the wall of the body 1 of the apparatus and the motor 3 which is held in position by radial supports 56 so as to allow the passage of air.

It is seen clearly that the apparatus according to the invention differs fundamentally from conventional curling irons in which steam may have been applied to the lock.

In effect, in the apparatus according to the invention, two basically different and distinct treatments of the hair are carried out.

In a first stage, the flow of air is stopped and superheated steam is introduced, whilst in a second stage the emission of steam is stopped and a stream of air at ambient temperature is directed onto the hair.

The apparatus according to the invention differs from previously known apparatuses due to the fact that the hair wound up on the element 38 of the apparatus is not intended to be heated by conduction from the body 38.

In fact, according to the invention, this body 38 consists of a thin metal wall, or a thicker insulating wall, which has a very low thermal inertia and which is instantly brought either to the temperature of the steam emitted in the superheated steam emission stage, or to ambient temperature by the fast moving air which flows through the wall of this element 38.

As a result, the hair wound up on the element 38 is never subjected to heat transmitted by conduction and is either treated at a uniform temperature by the mass of steam which diffuses through the hair or cooled uniformly by the flow of cold air.

In contrast, in the case of previously known steam curling irons, the hair was constantly subjected to heat transmitted to it from the mandrel on which it was wound up, and furthermore the steam was passed in intermittently. As a result, with the previously known apparatuses, it was not possible uniformly to cool the hair when it was placed on the apparatus.

It is also obvious that the cartridge 44 which is actuated by the push-button can easily be replaced so as to change the nature of the liquid which is vaporised, which makes it possible to carry out successive treatments with different chemical products.

Several embodiments of curlers which can with advantage be used in the process according to the invention have been shown in Figures 10 to 16.

In Figure 10 there has been shown schematically a curler, or wave-setting roller, which consists, in the conventional way, of a cylindrical bore 57 equipped with spikes similar to brush bristles, arranged radially and intended to catch the hair. This curler, or wave-setting roller, is equipped with two circular end flanges 58 intended to rest on the scalp 59 and keep the hair away from the scalp so as to prevent the steam issuing from the curler from heating the scalp to too high a temperature.

The steam is injected by inserting the injection needle through the hair wound up on the curler.

The variant of roller shown in Figures 11 and 12 comprises a curler 60 of conventional type which, after having had the hair wound up on it, is placed in a clamping gripper 61 which surrounds it over more than half its periphery and which is provided with feet 62 intended to rest on the scalp 59. A side view of the gripper 61 placed over the curler has been shown in Figure 12.

In the variant of Figures 13 and 14, a hair pin 63 of a particular shape is used simultaneously to fix the lock of hair to the curler 60 and to keep the curler at a distance from the scalp 59. To achieve this, the pin has an arched shape at 63a so as to rise clear of the scalp.

Figure 14 shows as a side view the U-shape of the pin shown in end view in Figure 13, which thus plays the function of a double pin and correctly holds the curler 60 in place above the scalp.

In the embodiment of Figures 15 and 16, a hollow pin 64 equipped with orifices 65 is used to hold the lock of hair on a curler 60 (for example a curler equipped with end

flanges 58 as in Figure 10). To carry out the steam treatment according to the invention, it thus suffices to push the steam injector needle (7, Figure 1) into the pin 64.

A throat 66 located at the entry of the pin 64 makes it possible to facilitate this introduction (of the injector needle 7).

Figure 17 shows an injection device which can in particular be used in place of the injector needle 7 of the apparatus of Figure 1.

This device comprises a hollow injector needle 67 intended to be connected to the vaporising element (not shown in Figure 17) of the apparatus, and a protective element consisting of a rubber bellows 68 and a conical tip 69. The needle 67 is mounted at the front part of the apparatus by means of a fixing element, such as a screw 70 axially pierced by a throughbore to communicate the needle 67 with the steam supply. A rubber washer 71 mounted around the needle 67 serves as a deflector for the superheated steam emitted by the apparatus.

Figure 18 shows a different embodiment of the apparatus shown in Figure 8.

This embodiment shows a motor 3 which drives a fan 4 to pass a stream of air into the body of the apparatus, as in the embodiment of Figure 8.

The embodiment of Figure 18 furthermore provides a device consisting of a rectifier 72 and a polarity reversing switch 73 to change the direction of rotation of the motor 3 and of the fan 4, the usefulness of which will be described later.

As in the embodiment of Figure 8, the body 1 of the Figure 18 apparatus, housing the motor 3, fan 4 and the device for reversing the running direction of the motor, is connected to a tubular part 38 equipped with peripheral orifices. An articulated gripper 40 controlled by a handle 41 and also perforated can be applied against the tubular body 38 or be removed therefrom in the manner of the grippers of a curling iron.

The tubular part 38 includes both a cartridge 44 containing the liquid to be vaporised, and a vaporising element.

The end of the cartridge 44 has a metering nozzle consisting of a sleeve 74 inside which is mounted a piston 75, the end of which comes into contact with the liquid contained in the cartridge 44. The rod of the piston 75 is equipped with a peripheral thread corresponding to an internal thread of the sleeve 74, and the rotation of the piston rod relative to the sleeve makes it possible to advance the piston 75 into the cartridge 44 by a defined distance, so that when using the apparatus and axially sliding the sleeve 74, and the piston 75 threadedly engaged therewith, from left to right dispenses a defined quantity of the liquid contained in the cartridge 44 for injection into the vaporising element. Thus, after one dispensing operation the sleeve 74 cannot be withdrawn and the piston 75 then screwed in further towards the cartridge 44 so that the sleeve 74 can again be pushed home, to dispense a quantity of liquid depending upon the distance of the threaded piston advance.

The vaporising element comprises a vaporising chamber consisting of a helical groove 76 machined between an outer body 77, for example made of brass, and an inner body 78, also made of brass. The vaporising element has an internal resistance heater 79, preferably controlled by a thermostat. The vaporising chamber 67 is connected to the cartridge 44 by a conduit 80.

In operation, in contrast from the device of Figure 8, the stream of air provided by the fan 4 and passed into the mass of wound-up hair is not interrupted whilst steam produced in the chamber 76 and originating from the liquid contained in the cartridge 44 is passed over the hair. At the end of the treatment, in order to accelerate the cooling of the wound-up lock of hair, it is advantageous to reverse the direction of rotation of the fan 4, by means of the motor reversing device, so that the fan now draws cooler external air through the wound-up hair, after which the air passes into the now warm interior of the body 1 of the apparatus; this ensures more rapid cooling of the hair and reduces the total duration of the treatment.

Other embodiments of the apparatus according to the invention have been shown in Figures 19 and 20.

The apparatus shown in these Figures comprises an external envelope 81 which has, on its front part, an element in the form of a dome 82, preferably made of flexible rubber, into which passes a hollow injector needle 83, for example, such as that shown in Figure 3a, having four orifices pointing obliquely backwards at an angle of 45°.

The injector needle 83 is connected by a conduit 84 to a vaporising element again consisting of a vaporising chamber 85 in the form of a helical groove defined between an external element 86 having a high thermal inertia and made in particular of brass, and an internal element 87, also made of brass. A resistance heater 88 is located inside the element 87.

A thermostatic switch 89, in series with the resistance heater 88, is located near the end of the chamber 85 close to the inlet orifice for the liquid to be vaporised. The thermostatic switch faces the helical where the vaporisation takes place, the superheating taking place at the opposite end of the chamber. The function of this

thermostatic switch is to close the electric circuit as soon as the temperature becomes too low, that is to say as soon as the vaporising operation requires too great a supply of heat energy.

In the embodiment of Figure 19, the reservoir 90 is of the disposable type and consists of a chamber of polyvinyl chloride, rubber or any similar material. This reservoir placed in position at the rear part of the apparatus has a front wall 91 which, when the cartridge 90 is placed in position on the apparatus, is pierced by a hypodermic needle 92 which communicates with the vaporising chamber 85.

The cartridge 90 has a rear part 93 to be pressed by the user of the apparatus to send a desired quantity of the liquid contained in the cartridge through the needle 92 into the vaporising chamber.

Steam is then passed into the hair through the injector needle 83.

In the embodiment of Figure 20, the reservoir 94, again made of a flexible maerial, has at its rear part a filling orifice 95 closed by a protective stopper 96. This reservoir is placed in position within a cylinder 97 which can slide relative to the body 81 of the apparatus.

A tube 98 allows the liquid contained in the reservoir 94 to pass into the vaporising chamber 85.

In order to operate the device to emit a defined quantity of superheated steam through the injector needle 83, the user slides the cylinder 97 from right to left in Figure 20, which compresses the flexible envelope defining the reservoir 94 and drives a desired quantity of liquid from the reservoir into the vaporising chamber to be first vaporised then superheated and discharged through the injector needle 83.

The embodiments of Figures 19 and 20 provide great simplicity of operation and permit use by non-specialist users whilst giving great safety and a high efficiency of treatment.

In order that the invention shall be better understood there will now be described several examples of carrying out the process according to the invention.

## EXAMPLE 1

To effect a wave-set with the process according to the invention, hair which was initially dry, that is to say the hair contained an average of 5 to 20% by weight of water, was wound up on curlers of 10 mm. diameter.

Superheated steam at a temperature of 130°C. was injected for a period of 5 seconds by means of a device such as one of those described previously in conjunction with simple curlers or wave-setting rollers. A quantity of 0.2 $cm^3$ of water per roller was injected in the form of superheated steam.

The experiment was carried out on natural hair and on bleached hair. To measure the efficiency of the process the percentage retention, also called the wave-set yield, was determined in each case. This percentage retention is determined as follows:

A lock of hair, before a wave-setting treatment, has a length LO as measured between the roots and the ends. After a wave-setting treatment on curlers of a given diameter this lock is suspended vertically by the roots and after a time $\theta$ a distance L between the roots and the curled ends of the lock can be measured. The percentage retention is defined as being the ratio

$$\frac{LO-L}{LO} \times 100$$

The wave-set is the better, the higher is this ratio. In order to define this ratio accurately, it is important to carry out the measurements under defined conditions of temperature and humidity and to measure the length L after a defined time. In all the experiments carried out, this length L was measured after 2 hours, the temperature being 26°C. and the relative humidity 55%.

In the experiment carried out with natural hair treated according to this example, the percentage retention was measured as being between 30 and 35%, that is to say noticeably better than the percentage (generally between 20 and 25%) obtained with conventional wave-sets.

The experiment carried out on bleached hair gave a percentage retention of between 35 and 40% whilst with a conventional wave-set under optimum conditions percentage retention values of 25 to 30% were obtained, with the same hair.

In addition to the markedly superior hold characteristics, it was found that the hair appeared glossier and more springy and the impression of body was improved. Furthermore, it was found that greasy hair took longer to become greasy again.

It may be noted that drying a complete head in accordance with the invention takes about 10 minutes whilst a conventional wave-set on curlers requires about 40 minutes, so that there is a considerable gain in time and comfort as far as the users are concerned.

## EXAMPLE 2

A wave-set was carried out in accordance with the invention, the hair first of all being washed with a customary shampoo. After partial drying, the locks of hair, which were still moist in that the hair contained more

than 20% by weight of moisture, were wound up on curlers of 20 mm. diameter.

Steam was injected at a temperature of 120°C., over a period of about 10 seconds, the quantity of water vaporised per roller being 0.5 $cm^3$.

Thereafter, drying was completed under a hood for 20 minutes at a temperature of 55°C. and the hair was later allowed to cool to ambient temperature.

A wave-set was obtained which exhibited markedly better hold characteristics than that of conventional wave-sets.

Thus, an experiment carried out on natural hair showed a percentage retention of 35 to 40% and an experiment on bleached hair showed a percentage retention of 40 to 45%, determined as indicated in Example 1.

## EXAMPLE 3

A wave-set was carried out on dry hair by means of the apparatus shown in Figure 18.

A lock was wound round the tubular part 38 which had a diameter of 19 mm. Warm air was passed over the lock of hair by means of the fan for about 10 seconds.

An amount of 0.5 $cm^3$ of water in the form of steam at 110°C. was injected over a period of one second.

The treatment with warm air was continued for a period of about 10 seconds to remove all condensation. The running direction of the motor was then reversed to cause cool air to pass through the hair, ensuring complete cooling. This operation took about 10 seconds.

The total operation on one lock took 30 seconds in all. For natural hair, the percentage retention was 35% and for bleached hair the percentage retention was 52%, that is to say the results were superior to the equivalent values of 26% and 44% respectively obtained by means of a conventional steam curling iron.

The hair also showed increased gloss and springiness.

## EXAMPLE 4

Straightening of hair was carried out in accordance with the invention, that is to say an attempt was made to obtain straight hair from crimpy or wavy hair.

Curlers of 50 mm. diameter were used, on which was wound dry hair, which may or may not have been washed beforehand. 2 $cm^3$ of water per roller, in the form of steam at a temperature of 150°C., were injected in accordance with the invention during a period of about 30 seconds. The hair was then dried at a temperature of less than 70°C.

The results obtained were markedly superior to those which can be obtained with a conventional wave-set using curlers of the same diameter.

## EXAMPLE 5

To produce a permanent set of hair by the process according to the invention, moistened locks were impregnated with an aqueous solution containing 0.2% by weight of ammonium thioglycollate and having a pH of 9.3.

The hair was wound up on permanent-waving curlers of 6 mm. diameter.

Steam, superheated to a temperature of about 110°C., was injected for about 1 minute.

The locks were then cold rinsed if appropriate.

Thereafter, the hair was fixed in a conventional manner, either with a solution of hydrogen peroxide or with a conventional oxidising composition for carrying out the second stage of permanent waving of hair.

A permanent change of shape of the hair was thus obtained, with a particularly good yield of curls, that is to say with the curls formed having good resistance to subsequent changes in shape.

It is noteworthy that a result of this quality can be obtained with a reducing composition in which the concentration of thiol is as low as 0.2%.

In a variant of this process, instead of carrying out the second stage of fixing with an oxidising solution, atmospheric air can be used in accordance with a method which is already known.

## EXAMPLE 6

The hold of wave-sets effected on hair can be improved by carrying out the technique of lanthionisation of the hair by chemical treatment during the process according to the invention.

For this, moistened but nearly dry hair was impregnated with a gel having the following composition:

| | |
|---|---|
| Lithium bromide | 26% |
| Hydrated lithium hydroxide | 2% |
| Hydroxyethylcellulose WP 4400 | 4% |

This gel had a pH of 10.9.

The hair was wound up on curlers and was treated by injecting steam at a temperature of about 110°C.

The degrees of lanthionisation, i.e. transformation of the keratocystine into lanthionine, achieved were 20% for a steam treatment lasting 30 seconds but only about 33% if the steam treatment is extended to about 80 seconds.

## EXAMPLE 7

The wave-set of hair was strengthened by

impregnating a lock of hair with a 5% strength aqueous solution of glyoxal.

The hair wound up on curlers was dried under a hood for 30 minutes and then subjected to a treatment with steam at a temperature of about 120°C. for 40 seconds, and then cooled.

This treatment gave an improvement in the hold of the wave-set.

An improvement of the reinforcing effect on hair of conventional reinforcing agents in aqueous or aqueous-alcoholic solution was also found on employing the process of the invention.

For example, excellent results were found with polymers such as polymers of vinylpyrrolidone and diallyl-dimethylammonium bromide in the form of a 1 to 3% strength solution in water, of pH 5 (adjusted with tartaric acid), polymers of vinyl acetate, allyl stearate and allyloxyacetic acid, as a 3% strength solution in water, of pH 5 (adjusted with lactic acid) and cyclic polymers of poly-diallyl-methyl-dodecyl-ammonium bromide in solution in absolute alcohol.

It is interesting to note that these products, applied with the superheated steam treatment, improved the hold of the hair obtained as compared with the results obtained with superheated steam alone, whilst the application of the majority of the polymers without superheated steam treatment results in practically no improvement in hold.

Excellent results were also found by fusion of products deposited as a powder on dry hair or of products deposited from suspensions on moist hair.

For example, carnauba wax, thymol, stearic acid, paraffin, salicylalcohol, beeswax, and coloured waxes have been used in this way and give excellent results.

## EXAMPLE 8

Hair was dyed by means of an 0.25% strength aqueous solution of nitro-*para*-phenylenediamine containing 5% of a dispersing agent consisting of an oxyethyleneated oleyl/cetyl alcohol, with 25 mols of ethylene oxide, sold commercially under the name of Remcopal.

Previously bleached hair or grey hair was impregnated with this solution.

Superheated steam was injected into the hair, when the hair was nearly dry, for about 40 seconds at a temperature of about 120°C.

The hair was found to be dyed with a particularly high tinctorial strength.

## EXAMPLE 9

Hair was dyed by means of a solution of 10 g. of methylene green per litre, in an ammoniacal medium.

The hair was impregnated with this solution, wound up on curlers of 30 mm. diameter, and then when nearly dry, subjected to the treatment according to the invention for a period of 30 seconds during which 3 $cm^3$ of water per roller, in the vaporised form, at a temperature of 105°C., were injected. Cooling of the hair then followed.

A spectacular increase in the fixing of the dye (normally difficult to fix) was achieved.

## EXAMPLE 10

The hair was restructured by means of a 3% strength solution of trimethylolmelamine, of pH 2 (adjusted with HCl).

The hair was wound up on curlers of 25 mm. diameter and, when nearly dry, was subjected to a steam treatment entailing 15 injections, each of one second duration, of steam at 135°C., the total amount of solution used per roller being 2 $cm^3$.

Better results were obtained than when the solution alone was applied.

## EXAMPLE 11

To produce a permanent set of hair, a 4% strength by weight aqueous solution of ammonium sulphite $(NH_4)_2SO_3$ was used.

This solution was placed in the reservoir of the steam-generating apparatus.

When the hair had been wound up on curlers, and was nearly dry, the superheated steam resulting from the vaporisation of the above-mentioned aqueous solution was passed for 30 seconds through the lock of hair wound up on curlers of 6 mm. diameter.

5 Volumes strength hydrogen peroxide was then introduced into the reservoir of the steam-generating apparatus and the vapour resulting from this solution was passed through the hair for 30 seconds.

This resulted in the reconstitution of the keratin links previously broken by the treatment with ammonium sulphite which, on decomposition, evolved $SO_2$ gas and $NH_3$ gas.

After cooling, a good permanent change in shape of the hair was thus obtained.

In a variant of this process, instead of using a solution of ammonium sulphite for carrying out the first stage of the reduction, a 5% strength aqueous solution of hydrazine hydrate can be used.

The hydrazine solution can also be used to impregnate a spongy mass placed inside the curler, with the superheated steam, penetrating into the spongy mass serving to carry the treating composition into the hair.

It was found that in this variant it was not necessary to carry out fixing by chemical means and that this fixing could easily be carried out with atmospheric air.

EXAMPLE 12

Dry hair was wave-set by following the procedure indicated in Example 2, the reservoir of the apparatus having been filled with a 9% strength azeotropic solution of benzyl alcohol in water.

After the treatment and cooling, the results found with regard to the hold of the wave-set were as good as with water alone vaporised as in Example 2, and in addition a significant improvement in the ease of untangling the dry hair was found. No residual odour was noticed.

EXAMPLE 13

Dry hair was wave-set in accordance with Example 2 with a 1.6% strength solution of diethyl phthalate in water introduced into the reservoir.

After cooling, the hold characteristics obtained were as good as with water alone but in addition there was an improvement of close to 9% in the coefficient of friction of the hairs against one another.

EXAMPLE 14

The hair was wave-set as in Example 2 but firstly 6 volumes strength hydrogen peroxide was introduced into the reservoir of the apparatus and secondly the hair was impregnated, before the steam treatment, with a solution having the following composition:

| | |
|---|---|
| Thioglycollic acid | 0.5% |
| Vinyl acetate/crotonic acid copolymer pH 2.6 | 1.5 g. |
| Water, q.s.p. | 100 cm³ |

An excellent hold of the wave-set, with a slight permanent crimp in spite of the very low concentration of thiol, was obtained.

EXAMPLE 15

Hair was wave-set as in Example 2, the reservoir of the apparatus according to the invention having been filled with 3 volumes strength hydrogen peroxide and the hair having furthermore been impregnated, before the steam treatment, with a lotion having the following composition:

| | |
|---|---|
| Thiolactic acid | 0.2% |
| Vinyl acetate/vinylpyrrolidone copolymer | 2 g. |
| pH | 2.9 |
| Water, q.s.p. | 100 cm³ |

A very good hold of the wave-set was obtained, which is even better than that obtained with a reinforcing lotion.

Of course, the embodiments which have just been described above are not in any way limiting in character and can be modified in any desirable way without thereby going outside the scope of the invention as defined by the following claims.

In particular, it is clear that the process according to the invention is not limited to wave-setting of the hair but can equally be applied to all sorts of treatments with superheated steam, which treatments make it possible to carry out all sorts of chemical reactions on the hair, such as permanent changes of shape, dyeings, or treatments to reinforce or strengthen the hair.

Finally, it is obvious that the process according to the invention is not limited to the case or wave-setting or of a treatment carried out on curlers or wave-setting rollers but can equally be applied to cases where it is desired to carry out wave-sets or treatments of crinkly hair which is to be brought to a less wavy form than its natural state, especially by straightening as in Example 4.

WHAT WE CLAIM IS:—

1. A process for treating hair, comprising supporting at least one lock of hair in a desired configuration either when dry or nearly dry, applying uniformly to the hair superheated steam at a temperature of above 100°C and for a period of up to 60 seconds, and maintaining the hair in said configuration while it then cools to ambient temperature.

2. A process according to Claim 1, when carried out on dry hair which has not just been washed.

3. A process according to Claim 1, when carried out on hair which has just been washed and which is nearing the end of a drying operation.

4. A process according to any one of the preceding claims, wherein after application of the steam in the superheated phase, the cooling is carried out by passing a stream of air at ambient temperature into the hair.

5. A process according to any one of the preceding claims, and comprising applying to the hair steam superheated to a temperature of between 100° and 150°C and containing chemical compounds which have an action on the hair.

6. A process according to Claim 5, wherein the hair is first treated with superheated steam containing a reducing agent and is then treated with superheated steam containing an oxidising agent, so as to produce a permanent set of the hair.

7. A process according to any one of the preceding claims, wherein, before the application of the superheated steam to the hair, the hair has previously been impregnated with a chemical composition, or wound up on curlers or rollers which have beforehand been impregnated with a chemical composition.

8. Apparatus for carrying out the process according to any one of the preceding claims, comprising a vaporising element which comprises a resistance heater and is communicated with an injector adapted to be engaged in, or applied against, the hair to be treated; a pumping device connected to a reservoir and to said vaporising element for delivering a predetermined quantity of a liquid from said reservoir into the vaporising element to be discharged via the injector in the form of steam at a temperature above 100°C., and a blowing and/or suction device for generating, and discharging adjacent said injector, a stream of air at ambient temperature.

9. Apparatus according to Claim 8, comprising means for giving a signal to pass liquid into the vaporising chamber and for causing the stream of air to stop.

10. Apparatus according to Claim 8 or 9, wherein said blowing and/or suction device is connected to a discharge outlet arranged to direct the stream of air around the injector.

11. Apparatus according to Claim 8 or 9, wherein the said blowing and/or suction device is connected to a discharge outlet arranged to direct the stream of air alongside the injector to enable the air to flow towards the scalp instead of being passed around the injector.

12. Apparatus according to Claim 11, wherein the air is discharged in the form of a curtain from a slot diffuser.

13. Apparatus according to any one of Claims 8 to 12, wherein the injector consists of a hollow needle the end of which is rounded and which has near this rounded end, a plurality of orifices to allow steam to discharge therethrough.

14. Apparatus according to Claim 12, wherein the orifices are oblique relative to the axis of the needle and point backwards.

15. Apparatus according to any one of Claims 8 to 12, wherein the injector is surrounded by a telescopic protective sleeve, which, in the state of rest, is urged outwards to shut off outlet orifices of the injector and to allow the vaporising element to be connected to further orifices arranged laterally over the body of the apparatus, whilst in the operating position the protective sleeve is yieldably pushed backwards to expose the orifices located on the injector and to shut off said further orifices located laterally on the body of the apparatus.

16. Apparatus according to any one of Claims 8 to 11, wherein the injector has an outlet adapted to discharge a plurality of separate streams of superheated steam.

17. Apparatus for carrying out the process according to any one of Claims 1 to 7, including a superheated steam generator including a vaporising element, a tubular perforated body onto which a lock of hair may be rolled, means for introducing superheated steam from said generator into the interior of said tubular perforated body, and means for separately introducing cooling air into the interior of said body for maintaining said body at a temperature lower than 70°C.

18. Apparatus according to Claim 17, wherein said tubular body has a low thermal inertia.

19. Apparatus according to any one of Claims 8 to 18, wherein the vaporising element is provided with a thermostat which controls the superheating temperature of the steam.

20. Apparatus according to any one of Claims 8 to 19, wherein the vaporising element consists of a heating body which encloses metal shot through which the liquid, and the steam generated by the vaporising element, pass.

21. Apparatus according to any one of Claims 8 to 20, wherein the liquid to be passed into the vaporising chamber is contained in a pressure vessel.

22. Apparatus according to any one of Claims 8 to 20, wherein the liquid to be passed into the vaporising chamber is contained in a refill container.

23. Apparatus according to any one of Claims 8 to 16, in combination with a curler or wave-setting roller which curler or roller includes means for spacing a lock of hair wound on the curler from the scalp.

24. Apparatus according to Claim 23, and including a hollow pin by means of which the hair is to be fixed to the curler or to the wave-setting roller.

25. Apparatus according to Claim 24, wherein said pin has a throat which makes it possible to engage a steam injector inside the curler.

26. Apparatus according to any one of Claims 23 to 25, wherein said curler or roller includes a spongy mass adapted to be impregnated with a composition for the treatment of the hair.

27. A process for treating hair substantially as hereinbefore described with reference to any one of the foregoing examples.

28. Apparatus for carrying out the method of Claim 1 and substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 3, or Figure 3a, or Figures 4 to 6, or Figure 7, or Figures 8 and 9, or Figure 17, or Figure 18, or Figures 19 and 19a, or Figure 20 of the accompanying drawings.

29. Apparatus according to Claim 28 in combination with a curler or wave-setting roller substantially as hereinbefore described with reference to, and as

illustrated in Figure 10, or Figures 11 and 12, or Figures 13 and 14, or Figures 15 and 16 of the accompanying drawings.

30. Hair which has been treated by the process of any one of Claims 1 to 7 and 27.

J. A. KEMP & CO.,
Chartered Patent Agents,
14, South Square,
Gray's Inn,
London, W.C.1.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1978
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1512823 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

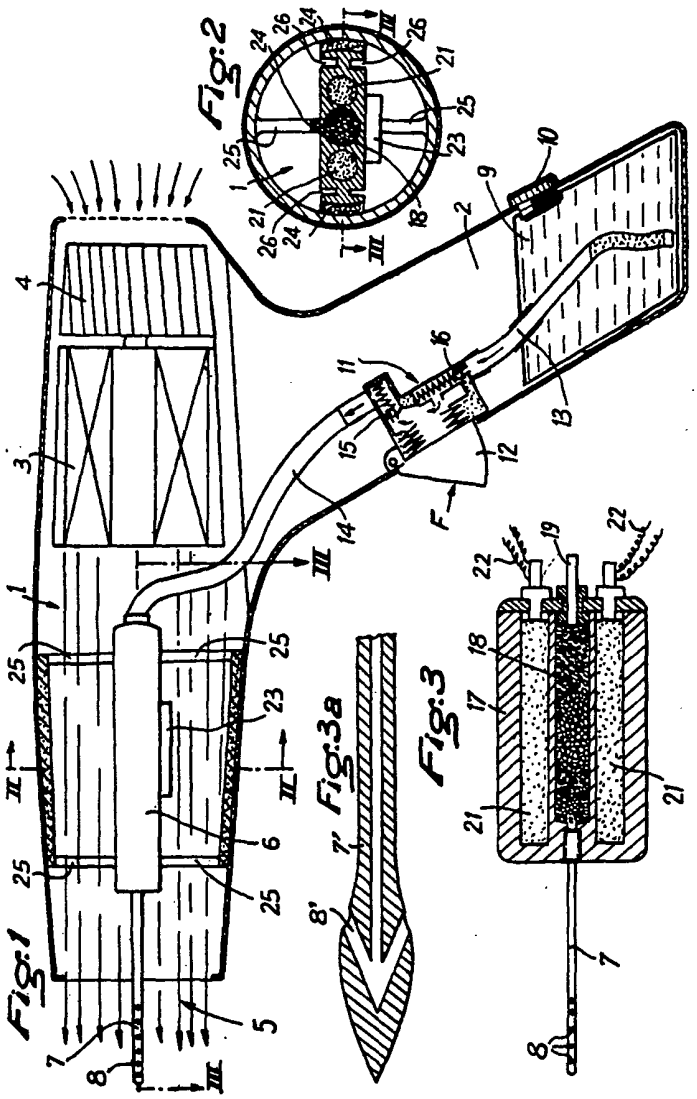


Fig:4

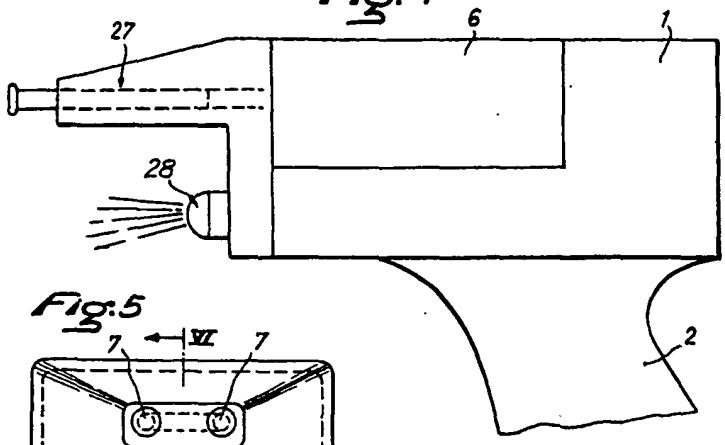



Fig:5

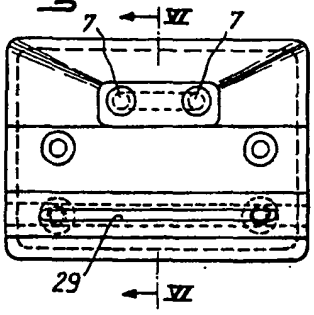



Fig:6

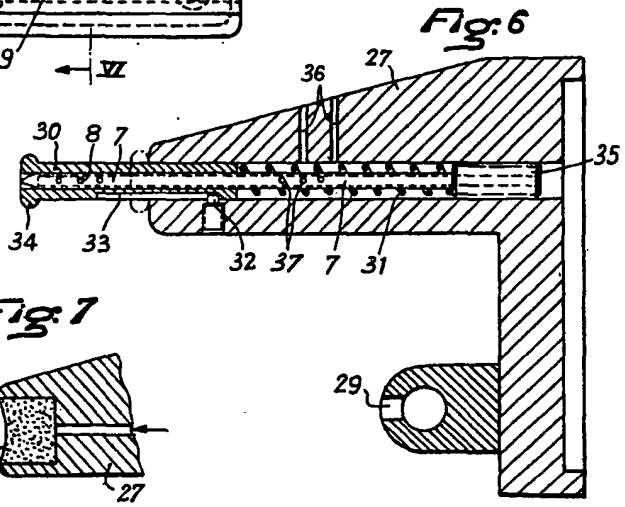



Fig:7

1512823 COMPLETE SPECIFICATION
5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

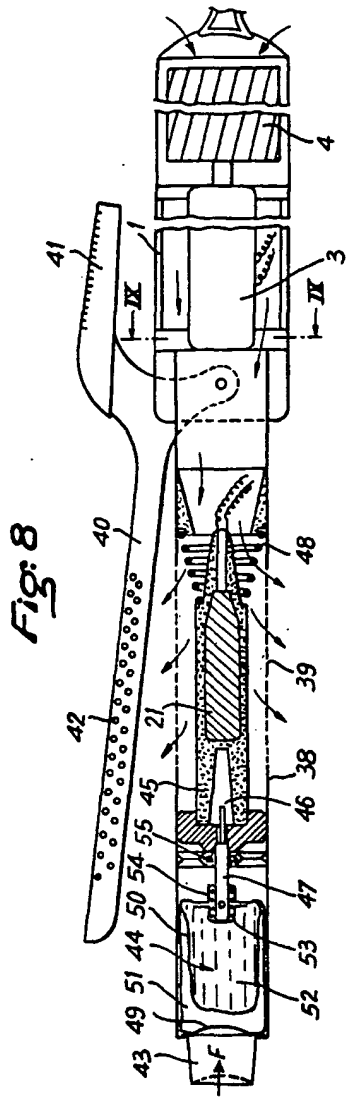



Fig. 8

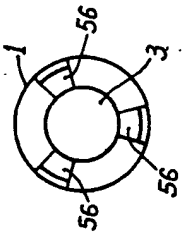



Fig. 9

Fig:10

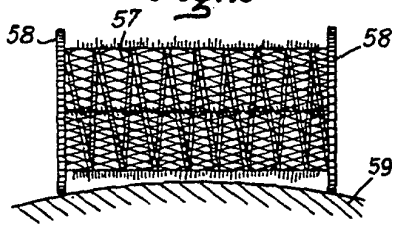



Fig:11

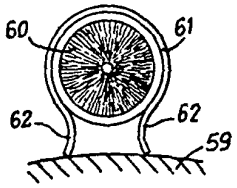



Fig:12

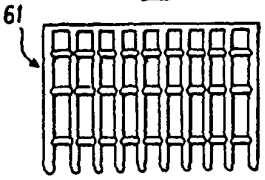



Fig:13

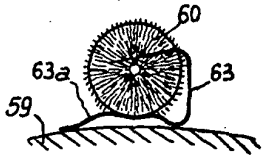



Fig:14

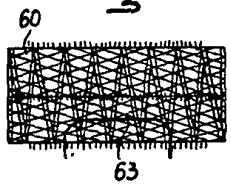



Fig:15

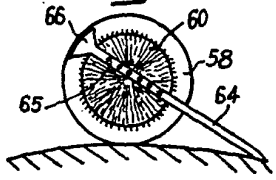
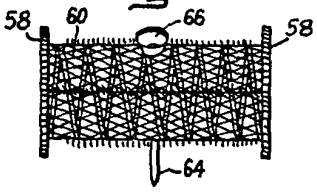



Fig:16



1512823 COMPLETE SPECIFICATION
5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 5